XXIX. *Account of ſome Experiments in Electricity. In a Lefer from Mr.* William Swift *to the Rev. Dr.* King, *F. R. S.*

Read April 29, 1779.

SIR,

Greenwich,
April 28, 1779.

BEING encouraged by the attention the Royal Society did me laſt year to give to the account of ſome electrical experiments I had made, which you were ſo good as to preſent to them, I take the liberty to beg their indulgence again, and hope you will be pleaſed to lay before them ſome new improvements I have made in my electrical apparatus. I ſhall eſteem myſelf very happy if what I have done is worthy the farther attention of that moſt learned and reſpectable body.

One particular addition I have made to the apparatus conſiſts in what I call an anti-conductor: it is exactly like the prime conductor, but it is fixed to the cuſhion of the machine, and conſequently, when the cylinder is put in motion, the anti-conductor is charged negatively, that is, the electric matter is diminiſhed therein in the ſame proportion

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portion as it is increaſed in the prime conductor in the ſame time.

Another thing peculiar to this machine is, that the whole is inſulated, ſo that being able to collect the electric matter without any connection with the earth, and having at the ſame time bodies or conductors poſitively and negatively electrified, I apprehend I am enabled by this apparatus to exhibit many experiments more analogous to the natural effects of lightning from the clouds, than it is poſſible to do with only one conductor poſitively electrified; becauſe in nature clouds are conſtantly flying in the air which are differently electrified, and, diſcharging themſelves in each other, produce the lightning often ſeen in the atmoſphere.

I have annexed a ſlight ſketch of the apparatus: *a* is the glaſs cylinder; *b* the prime conductor, on two glaſs ſtems; *c* the anti-conductor, on two glaſs ſtems, connected with the cuſhion of the machine; *dd* is a pole or round ſtaff, well covered with metal, with a ball ~~at~~ each end, which hangs over the two conductors *b* and *c*; this ſtaff is faſtened to the croſs pole *f*, which is ſuſpended by a ſilk line in ſuch a manner that the ſtaff *dd* is equally balanced.

It may be proper to mention a few common experiments and obſervations, to ſhew, that the two conductors

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are charged and differently charged, that is, the one poſitively or *plus*, the other negatively or *minus*, as ſoon as the cylinder is put in motion by turning the wheel; though, perhaps, this will not be doubted by any perſons converſant in electrical experiments, unleſs they have been fully perſuaded, that the electric matter cannot be excited without connecting the machine with the earth, which is not the caſe in this apparatus, for the glaſs cylinder and both conductors are inſulated.

1. When the cylinder moves, and a body approaches the prime conductor, ſuch body will draw a ſpark from that conductor at the ſame diſtance, and conſequently of the ſame length as will be drawn from the approaching body by the anti-conductor. And a pith ball is equally attracted by both, which ſufficiently ſhews, that both conductors are charged or electrified.

2. The following common experiments will ſhew, that they are differently electrified.

I take a wire with a ſmall piece of cocoa wood, about one inch and a half long, pointed, faſtened to one end of the wire, and connecting the other end to the anti-conductor · as ſoon as a conducting body approaches it there is a bright ſpark reſembling a ſtar, which appears to ſettle upon the end or point of the wood; but when the wire is connected with the prime conductor, there iſſues from the end of the wood a pencil of rays diverging to the point towards the approaching body. which, I apprehend, demonſtrates the conductors to be differently electrified.

3. It may alſo be ſeen by another experiment. I take two jars, coated as in the Leyden experiment, and charge one by the prime conductor, the other by the anti-conductor; the firſt will be poſitively, and the ſecond negatively electrified; which is proved by applying a diſcharging rod to the balls connected with the inſide of the jars, when both immediately diſcharge themſelves, which they would not do, if both jars were charged from the ſame conductor.

Theſe experiments I only mention, to ſhew, that the two conductors are both electrified, and with this difference, that the one has more, the other leſs, electrical matter than in its natural ſtate.

4. When the pole *dd* is let down by ſlackening the ſilk line on which it hangs within the ſphere of action of the two electrified conductors, and being equally balanced remains *in equilibrio* over both, as ſoon as the cylinder begins to turn, the pole vibrates regularly towards each conductor, and as it approaches the one or the other gives a flaſh or ſpark.

In this ſtate if a ball be preſented to either conductor, it makes no alteration; the pole continues to vibrate as before, even though a flaſh comes on the ball: but when a point is preſented to either of the conductors *b* or *c*, the vibrations of the pole begin to abate, and no flaſh comes to the point. And as ſoon as any connection is made with the earth, the point being preſented to one conductor, the pole attaches itſelf to the other with continual flaſhes.

5. I take two glaſs globes coated *e e*, and ſuſpend them towards the ends of the pole *dd*. On turning the cylinder the pole will vibrate, and the globes will, in a ſhort time, become charged; each globe will have its outward coat charged in the ſame way as the conductor over which it hangs, as will appear by diſcharging them into each other with a common diſcharging rod. This experiment ſhews the poſſibility of compreſſing the electric matter, though the globes are perfectly inſulated.

6. While the machine remains in this ſtate, let the prime conductor *b* be connected with other clouds, fig. 2. which are made to move over houſes having conductors terminated with points; the globe *e* over the prime conductor will be thrown upwards or repelled, and the other globe only will receive a charge from the anti-conductor *c*: or if, on the contrary, the anti-conductor *c* be

connected with the flying clouds, the oppoſite globe only will receive its charge from the prime conductor. But if balls inſtead of points be made to terminate the conductors of the houſes, the globes *e e* will vibrate till both be equally charged.

7. Or if we take off the globes and place a large jar or battery to each conductor, and charge them by turning the cylinder till the electrometer riſes to ninety degrees, the ſtrokes of the vibrations of the pole *d d* become very ſtrong; then, by means of an inſulated rod, I place a point on the upper part of either conductor where the knob of the pole ſtrikes, and no exploſion will come on that point. But if inſtead of a point, a ball be ſo interpoſed, there will be an exploſion; and the larger the ball is, the greater the exploſion will be. In the latter part of this experiment, when the ball is interpoſed, if any perſon applies his finger to any wire on the board *w w w*, or to the ſolid pieces of marble ſtanding on the board, he will be ſenſibly affected with a ſhock every time the exploſion happens; but when the knob is in contact with the point in the former part of the experiment, as there is no exploſion, neither will his finger be affected on the marble or any part of the wire.

8. Another experiment, which ſeems to agree in effect with all the foregoing, is as follows.

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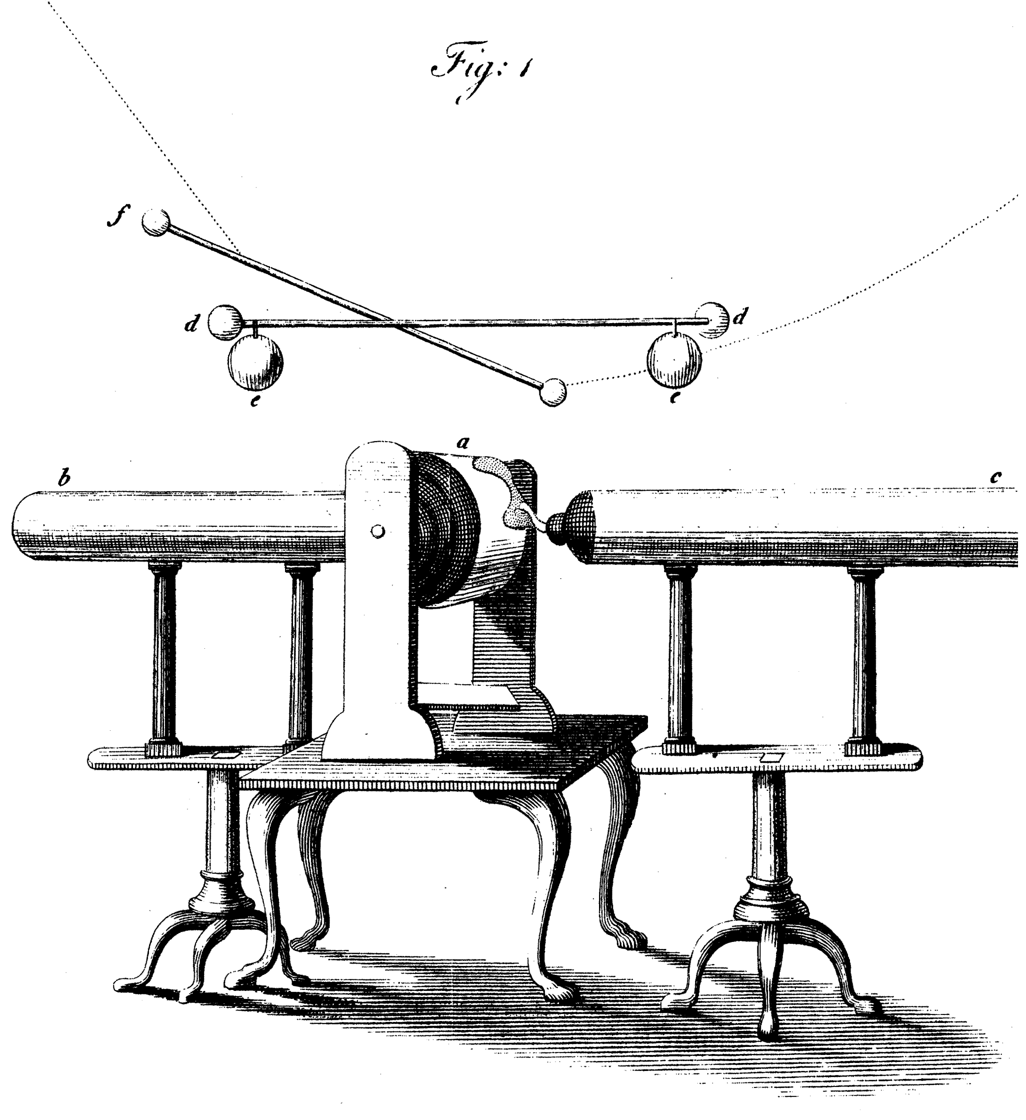
From either the prime conductor, or from the anti-conductor, I ſuſpend a metal ball which can ſwing like the pendulum of a clock; I then place on a level with it, at the diſtance of four or five inches from it, another ball fixed and connected with the earth; as ſoon as the cylinder begins to turn, the ſwinging ball begins to be attracted, and ſtrikes with conſiderable force againſt the fixed one, emitting a ſpark or flaſh at the ſame time.

In ſuch poſition if a point be put the vibrations of the ſwinging ball will immediately begin to leſſen, and it ſoon becomes intirely at reſt, no flaſh or ſpark happening from the inſtant the point is put there.

9. On one of the knobs or balls at the end of the pole *dd*, I put a point turned downwards towards the conductor, and as ſoon as the cylinder moves it is thrown upwards or repelled, and the oppoſite knob or ball adheres to the conductor under it; but when points are put on both knobs and turned downwards or towards the conductors, the pole *dd* will remain unmoved, notwithſtanding all the poſſible friction which can be given by turning the cylinder.

10. To render theſe experiments more analogous to the natural phenomena of lightning and rain deſcending from the clouds, I place a veſſel of water inſulated, and as the clouds (fig. 2.) being charged paſs along the frame,

Fig: 1



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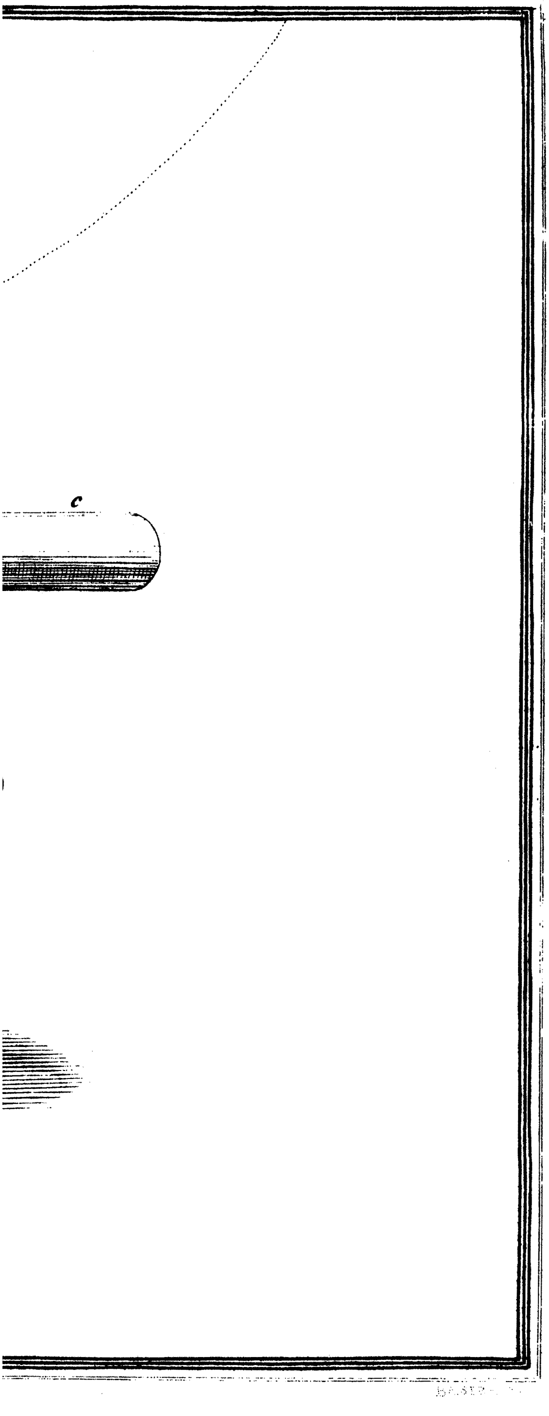

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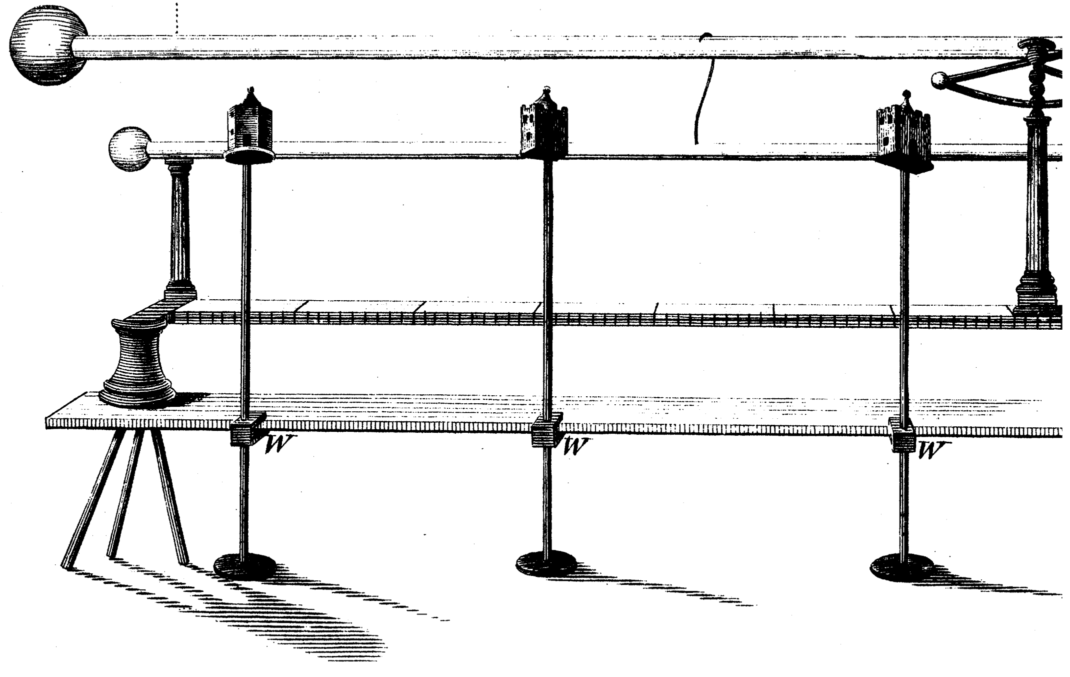
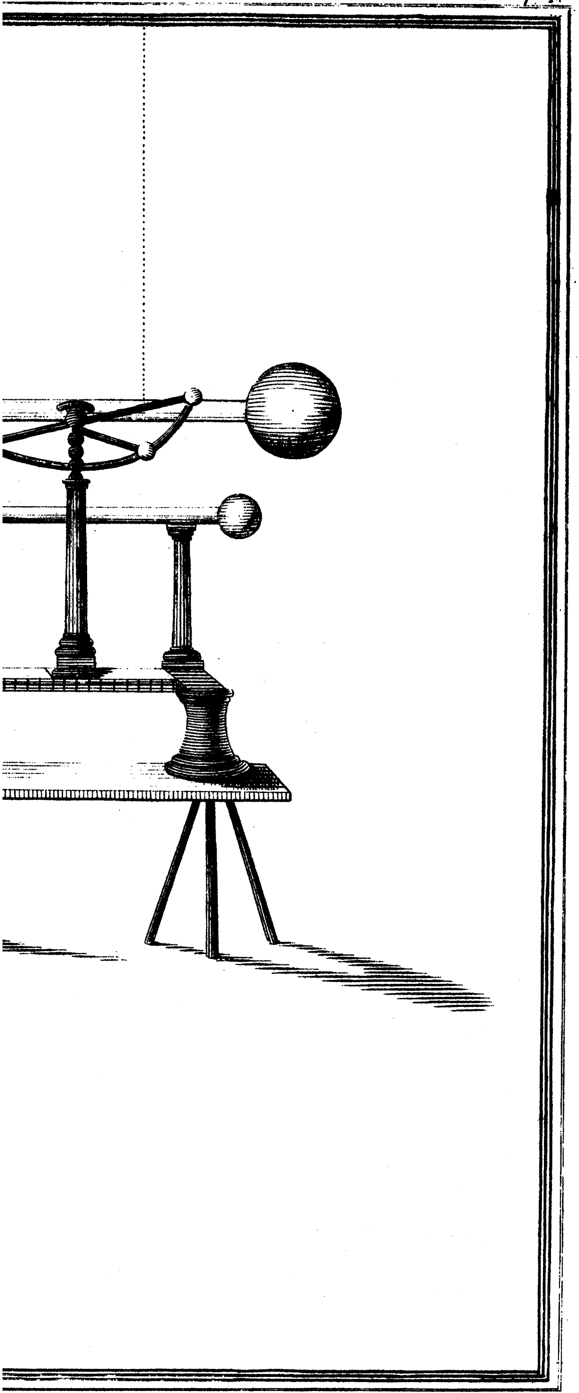
Fig: 2





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frame, they revolve over another cloud, which is introduced in the place of the middle houſe: all the houſes being taken away through this cloud, the water in the inſulated veſſel is made to paſs and to deſcend in a ſtream. When a ball is interpoſed between this cloud and the revolving ones, there will be frequent flaſhes upon it; but when, inſtead of a ball, a point is put there, the electric matter paſſes off gradually and ſilently without any flaſh.

Thus, SIR, I humbly apprehend, the whole current of theſe experiments tends to ſhew the preference of points to balls, in order to diminiſh and draw off the electric matter when excited, or to prevent it from accumulating; and conſequently the propriety or even neceſſity of terminating all conductors with points, to make them uſeful to prevent damage to buildings from lightning. Nay the very conſtruction of all electrical machines, in which it is neceſſary to round all the parts, and to avoid making edges and points which would hinder the matter from being excited, will, I imagine, on reflection, be another corroborating proof of the reſult of the experiment themſelves.

I am, &c.

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Fig: 1

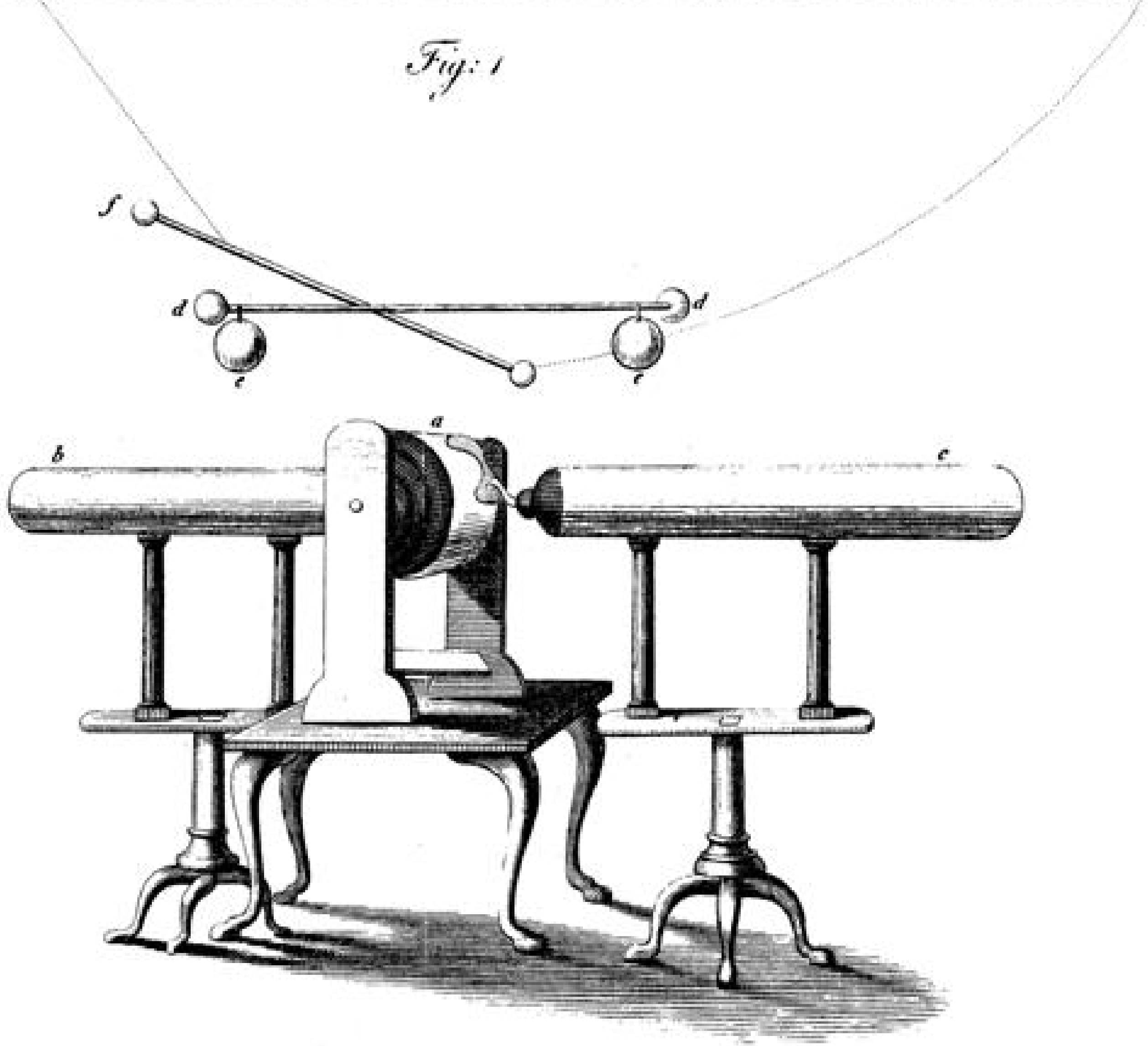
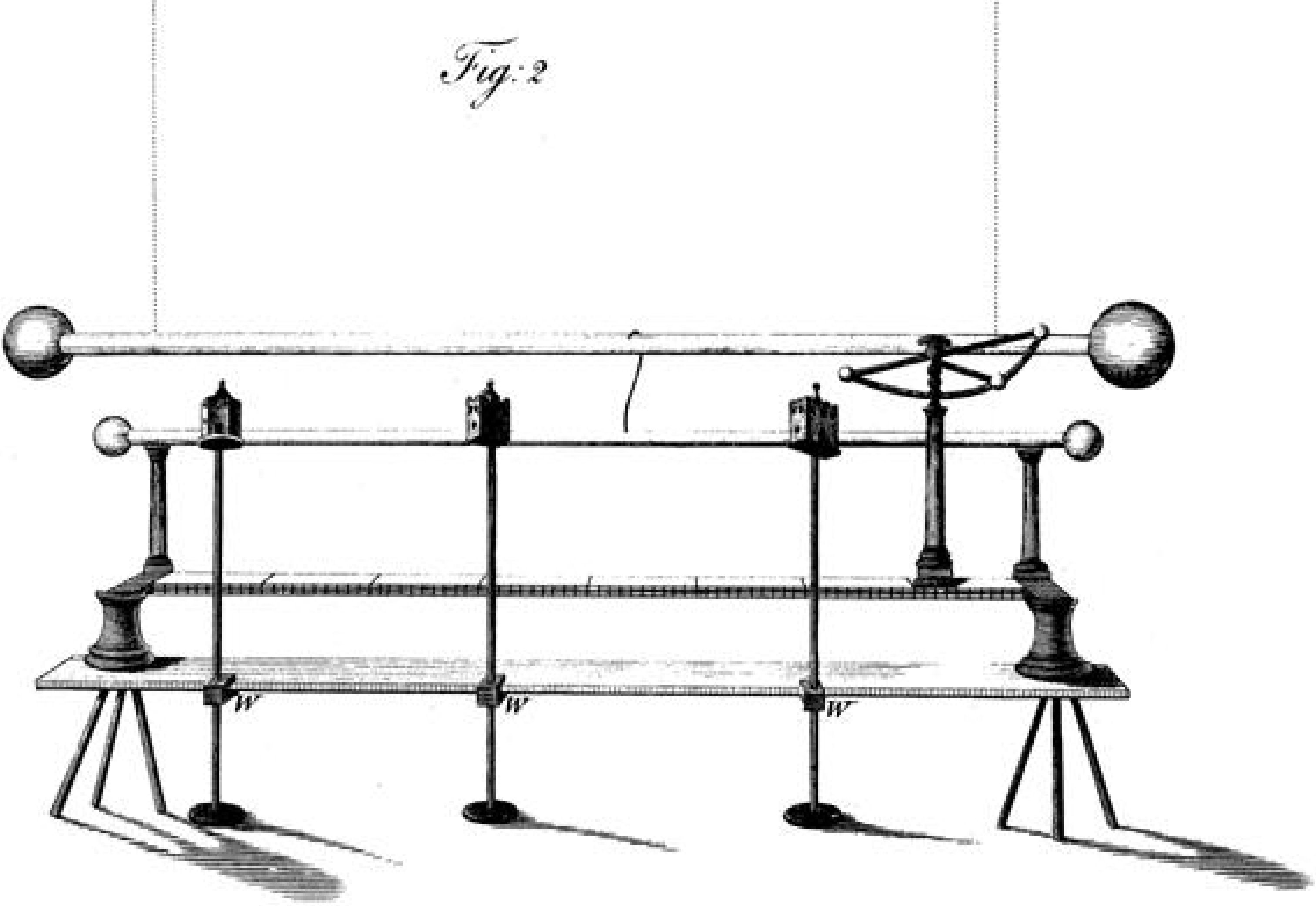


Fig: 2



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